IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of:	Dimitri P. Zafiroglu	Group Art Unit:	1771
Application No.:	10/611,470	Examiner:	Mathew D. Matzek
Filed:	July 1, 2003	Attorney Docket No.:	SWZ-010
		Customer No.:	29626

For: "TEXTURED COMPOSITE MATERIAL"

DECLARATION OF DIMITRI PETER ZAFIROGLU
PURSUANT TO 37 C.F.R. 1.131

I, Dimitri Peter Zafiroglu, hereby declare and make the following statements:

1. I reside at 303 Pentland Drive, Centreville, Delaware 19807.
2. I received a Bachelor of Science in Mechanical Engineering from Robert College, and a Master of Science in Mechanical Engineering from Yale University.
3. I am the sole inventor of the above-referenced United States patent application.
4. I was employed by E.I. DuPont de Nemours from 1962 to 2002. My last position with DuPont was Senior Research Fellow.
5. I am currently working as a consultant for DZ Consulting,Inc
6. I have conceived the invention as claimed in the above referenced patent application as early as January 29, 2002, as evidenced by the Notice of Invention attached hereto as Exhibit 1. A broad description of my invention is discussed in details from the bottom of page 1 to the top of page 3.
7. I followed up with a handwritten description and drawings dated April 24, 2002, attached hereto as Exhibit 2, which is date-stamped as being received by Jeffrey Lew, Esq., my patent attorney, on the same day. The drawing on the first page of this document is the predecessor of Figures 2 and 4 of the above referenced patent application.
8. I also reduced my invention to practice prior to June 12, 2002, as evidenced by my letter dated June 12, 2002 to Mr. Lew with two attachments, which is attached hereto as Exhibit 3.

9. The attachment B to the letter of June 12, 2002, is a forerunner of the above referenced patent application, and it contains Examples 1-4 shown on pages 11-19. These examples memorialize the prototypes that I have constructed and tested. These examples also form the basis for Examples 1-4 of the above referenced patent application.

10. To the best of my recollection, these prototypes took a number of weeks to make and test, and that I completed my work before June 12, 2002, which is the day that I sent the results to Mr. Lew.

I declare further that all statements made herein of my own knowledge are true; that all statements made herein on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Date: June 12, 2007

By: [signature]
Dimitri Peter Zafiroglu

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Date: June 12, 07

By: ____________________
Dimitri Peter Zafiroglu

SWZ, LLC

cc: W. R. Spencer
J. Wauford
R. I. Lacy

January 29, 2002

TO: SWZ, LLC FILE

FROM: D. ZAFIROGLU

SWZ, LLC CONFIDENTIAL

NOTICE OF INVENTION

THERMO-FORMED FLOORCOVERINGS

CASE S-0001

BACKGROUND

A variety of floorcovering constructions are available in the market. They range from thick and soft tufted, woven, knit, stitchbonded, needle punched and similar pile carpets, to hard surfaces such as wood or ceramic tile. The fibrous, softer and more texturable structures are less durable and less renewable/ serviceable, and tend to collect dust, dirt and bacteria in the fibrous interstices. There is a tendency in the world today to migrate towards wood or tile, or to more-closed , easily-serviceable surfaces, that maintain some of the features of the fibrous/decorative carpets. Examples of the latter are fabrics laminated onto various backings, starting with products marketed as "Solenium" by Interface, Inc. or flat-faced products, decorated with tufted yarns exposing most of the back ground, such as "Metafloor" by Lee's Carpets.

The shortcomings of the systems described above are that, unless the surface structure is opened up to resemble the tufted, knit, woven, stitched, or punched products, the range of cushion, softness, aesthetics and performance that they offer is limited.

Over the past month I started to examine the flooring systems available with the aim of creating a system that will satisfy most needs without opening-up the surface structure, and/or without relying upon conventional methods to create novel surface textures.

THE INVENTION

The basic discovery I made over the last two weeks is that a fabric or web that exposes free fiber ends or free loops of fibers, can be thermally laminated very effectively to fibrous backings of various densities if those backings also have free ends or loops exposed on

their surface. A layer of low-melting polymer (a low melt nonwoven, film, paper, layer of powdered polymer, etc.) can be placed between a face fabric and a backing and the two can be very effectively laminated using a surface temperature well above the melting point of the low-melt polymer layer (e.g. polypropylene), but well below the melting or softening points of the surface fibers or the backing fibers (e.g. nylon, polyester). Hot calendering (or hot pressing) requires extremely short heat application times and moderate pressures to make the low-melt polymer flow sufficiently to the interstices between the fibers of the face fabric and the backing to achieve extremely high resistance to delamination, without migrating to the front of the face fabric. This leaves the textile feel and "hand" of the surface fabric intact. The lower melting polymer envelops the face fabric fibers under the surface sufficiently to impart very high abrasion resistance to the face fabric, even if the fabric is not tightly woven, knit or stitched, or highly entangled or prebonded prior to the lamination process. Furthermore, the cut edges of the surface fabric do not fibrillate or unravel. Another advantage is that the fibrous backing does not have to be densified or collapsed with very high temperatures or pressures. Needle punched fiber backings of polyester or nylon can be laminated very efficiently to surface fabrics by applying heat from above and controlling the temperature, pressure and heating time to achieve excellent lamination with the face fabric fully-stabilized and the backing having its cushion and softness intact. In this manner a highly cushioning but durable and stable (and optionally decorative) floorcovering with equivalent cushion and durability to tufted (or knit/woven) carpets is created, without resorting to chemical adhesives, foams, etc.

Another very attractive feature of this invention is that the surface fabric can be three-dimensionally formed (or embossed) into the backing creating a permanently textured surface, that can resemble anything ranging from tufted, knit or woven carpet pile surfaces, to fine woven, knit or even velours type flat fabric surfaces. The starting fabrics can be woven, knit, or low-cost nonwoven webs, fabrics, or felts. The presence of the underlying thermoplastic binder guarantees that the embossed textures are preserved as formed, even after extended use. In this manner texture and cushion is imparted to low cost fabrics or webs, as they are supported by low-cost fibrous felts or equivalent structures, producing the feel and performance of expensive tufted, knit or woven products. The new structures can further be chosen to have a contiguous thermoplastic sublayer that conforms to the three-dimensional contour of the outside surface and blocks the collection of dust, dirt and bacteria. If desired, the product can also be constructed so that it will retard or block spilled liquids from going through, while still allowing the composite product to "breathe" (allow the escape of moisture). The fact that the binder layers applicable to this invention can be polyolefins, and therefore hydrophopic, greatly helps achieve this result. In fact, I observed that a polyester or nylon fabric laminated with a polypropylene layer to a nylon felt blocks the leakage of water through without blocking air flow. The face fabric becomes wet and no water comes through the binder layers. (To prevent the wetting of the face fabric it may be necessary to treat the formed product with repellents such as fluropolymers. The structures of this invention would require very little fluoropolymer).

The product can also be constructed with openings purposely formed by the embossing surface for the purpose of draining easily (as in the case of outdoor carpeting), or for allowing dirt or dust to filter through (door mats, abrasion pads), or simply for the purpose of creating highly decorative surfaces for floors, walls, auto's, seats, etc.

The product can also be formed with the thermoplastic polymer allowed to seep to the front face to create highly abrasion-resistant surfaces that still have a textile look and appearance.

Some of the features of this invention can also be achieved with a thermoset adhesive layer properly chosen to fulfill the functions of the thermoplastic low melt layer.

DEFINITION:

(1) A floorcovering product consisting of two fibrous layers laminated to each other with a interconnecting adhesive layer placed between the two fibrous layers wherein:

- The surfaces of the two fibrous layers placed against the adhesive layer exhibit free fibrous ends or free fibrous loops that intermesh with the free ends or loops of the opposite fibrous layers, and they are surrounded by the adhesive layer.

(2) The product of (1) wherein the adhesive layer is thermoplastic.

(3) Product of (1) or (2) wherein the fibrous layers contain staple-fibers with free staple ends protruding from the two faces engaging each other through the adhesive layer.

(4) Product of (1) or (2) wherein at least one of the fibrous layers consists of a continuous filament fabric with the surface fibers broken and exposing free-ends via sanding, or other abrasive action.

(5) The product of (1) or (2) wherein the adhesive penetrates through only part of one layer leaving a purely fibrous, adhesive-free surface.

(6) The product of (1) or (2) wherein one or both of the fibrous layers are three-dimensionally embossed with a (repeating or non-repeating) pattern.

(7) Product of 6 wherein the adhesive has penetrated partially through the depressed areas, leaving the raised areas free of surface adhesive.

(8) Product of (1) or (2) wherein the two fibrous layers are chosen from a group including wovens, knits, felts, spunbonded or spunlaced nonwovens, bonded nonwovens, warps or wefts or low-density staple yarns, air-laid webs, including brushed and/or sanded resins of these products.

(9) Product of (1) or (2) wherein the adhesive layer is hydrophobic.

(10) Product of (1) or (2) wherein one of the fibrous layers is at least twice as dense as the other fibrous layers.

(11) Product of (10) wherein the less-dense layer contains a thermoplastic or thermoset binder.

(12) Product of (6) wherein the depressed areas are perforated through into the next fibrous layer

(13) Product of (6) wherein the whole product is perforated through all layers to allow water drainage.

(14) Product of (9) wherein one of the two fibrous layers is also hydrophobic.

(15) Product of (14) wherein one of the two fibrous layers is treated with a water-repellent finish.

(16) The process of forming the product of Claims 1-15.

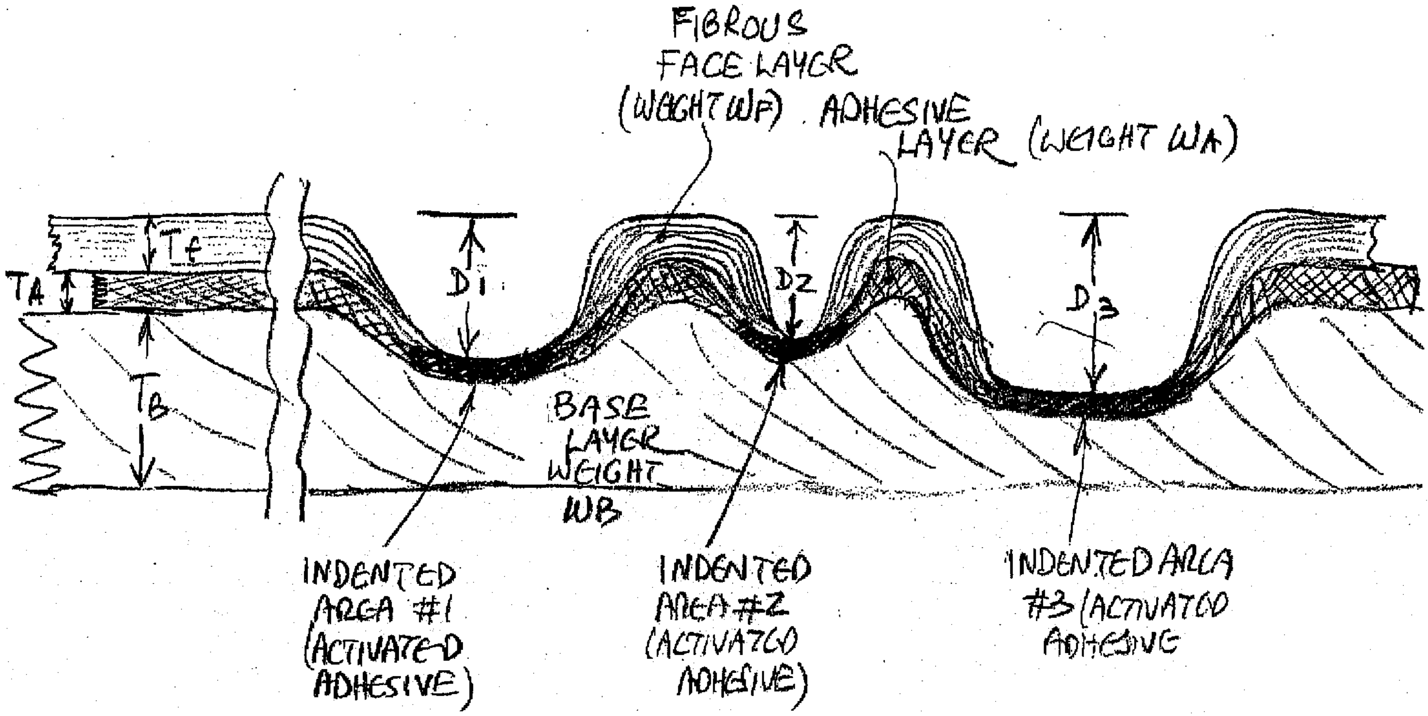
RECEIVED
APR 24 2002

S-0001

4/24/02 (1)

zafiroglu@aol.com

- U.S. search
- patentability
- reasonable cost



A. PRODUCT

(1) Composite floor, wall or seat surface COVERING CONSISTING OF three basic layers

- A fibrous "face" layer (a fabric containing staple or filament fibers) having a thickness T_f and a basis weight W_f in the range of 2-15 oz/sqyd.
- An "adhesive" layer with $W_A \geq 1/4\, W_F$
- A "base" layer with $T_B \geq 1$ mm and $W_B \geq 2W_f$

wherein

- The face layer is indented into the adhesive and base layers over 5-85% of its surface (total) area, with an average depth $D \geq T_f$.
- Essentially all fibers of the face layer within the indented areas are <u>surrounded</u> with adhesive. no loose fiber in indentation

PRODUCT (CONT.)

(2) Product of (1) wherein the base layer is porous

(3) Product of (2) " " " " " fibrous

(4) Product of (1) " " base layer and adhesive layers consist of a single thermoplastic layer.

(5) Product of (1) wherein D_i is 1-10 mm

(6) Product of (1) wherein the non-indented areas of the face layer are substantially free of adhesive on their exposed surface.

(7) Product of (1) wherein the non-indented areas of the face layer have at least one dimension smaller than 1/4 inch (6 mm).

(8) Product of (1) wherein the adhesive is water-repellent

(9) Product of (1) wherein the water penetration resistance of the product is at least 50 cm of "hydrostatic head", and the air vapor permeability is above 300 mg/sq.m./24 hr.

(10) Product of (1) wherein the entire face layer is impregnated with a thermoplastic polymer.

(11) Product of (1) wherein the composite is water-impermeable

(11A) Product of (1) wherein the indentations go through the entire product. holes ([illegible])

PRODUCT (CONT.)

(12) Product of (1) or (4) wherein the base layer is further fitted with a stabilizing/cushioning layer on its bottom surface opposite to the face layer — 4th layer

(13) Product of (1) wherein the indented/depressed areas assume the color of the adhesive by being largely imbedded in the adhesive, whereas the non-indented/elevated areas retain their original color. combination (S002 disclosure)

(14) Product of (13) wherein the adhesive layer has a color pattern that is visible through the compacted/indented/depressed areas

(15) Product of (12) wherein the base layer is softer and more compressible near the top adjacent to the face layer to provide a cushioning effect, and dense and stable in the lower strata to provide dimensional stability

(16) Product of (1) wherein the fibrous layer exhibits free fiber ends or loops imbedded in the adhesive layer or backing original S001

(17) Product of (1) wherein at least some of the indentations create perforations through the binder layer exposing the color(s) of the base layer (variation 13?)

B. PROCESS

(17) A process of forming a layered composite wall/floor/seat covering fabric by combining

- a fibrous face layer weighing 2-15 oz/sq yd
- an adhesive layer weighing 0.5-15 oz/sq.yd
- a base layer weighing 4-100 oz/sq.yd.

characterized by

- using a three dimensionally patterned heated forming tool that forms indentations that, on the average, are at least as deep as the thickness of the fibrous face layer, and cover 5-85% of the entire surface area
- causing the adhesive to flow into the face layer and to contact most of the fibers of the face layer located within the indented/depressed areas.
- curing the adhesive to form a surface-textured three-dimensional face-textured composite

(18) Process of (17) wherein the adhesive layer is thermoplastic and the forming tool is heated above the melting point of the thermoplastic adhesive layer, but below the melting point of the fibers

of the surface layer

(19) Process of (17) wherein the forming system is a platen-press.

(20) Process of (17) wherein the forming system is a heated calender with the roll contacting the face layer being a heated patterned roll.

(21) Process of (17) wherein the composite is "heat-set" by heating to at least 120°C and cooling while the product is held in a flat/planar configuration

(22) Process of (17) wherein the face layer is a

- nonwoven
- moldable woven
- knit
- card web
- air laid web
- spunlaid web ...
- knit with exposed loops
- woven of staple based spun yarns
- stitchbonded composite
- creped fabric.

(23) Process of (17) wherein the adhesive layer is

- a thermoplastic web or fabric
- a thermoplastic film
- a thermoset coating.

(24) Process of 17 wherein the base layer is
- a thermoplastic sheet
- a needlepunched nonwoven
- a woven

(25) Process of (17) wherein the face layer or base layer are sanded or brushed to raise free ends or loops...

S-0001

SEARCH "TERMS"

"Embossed"

"Textured"

"Laminate(d)"

"Composite"

"Multilayer"

"Carpet"

"Tile"

"Floor covering"

"Fabric"

SWZ, LLC

June 12, 2002,

Jeffrey Lew
Attorney At Law
2205 Silverside Rd
Wilmington, De 19810

CONFIDENTIAL ATTORNEY/CLIENT
PRIVILEGED COMMUNICATION
RE: S-0001/S-0002
YOUR REFERENCE: 47297

Dear Jeff,

REDACTED

I believe that we should proceed with the preparation of a U.S. Application, covering S-0001 and S-0002. As I also discussed on the phone, the earlier (non-professional) search I performed in April, did not discover pertinent Prior Art. I targeted U.S. and foreign applications/publications pertaining to laminate floor tiles, and focused on flooring and fiber companies that have been active in this field in the past 20 years. The definition I proposed on April 24, 2002 is still valid.

The list of references I collected in April are listed in Exhibit A. I hope that you do not mind extracting them from the Internet yourself, as my computer skills are very limited. The two most important ones are WO 9919557 and 5,965,232. Exhibit A also contains some comments and comparative sketches of these two references vs. S-0001/S-0002.

I also reviewed the original "Notices of Invention" regarding S-0001 and S-0002 dated January 29, 2002. I have no changes to make to S-0002 except that I now think it can be combined with S-0001. Regarding S-0001 itself, the definition has now changed, although all parts of the Invention remain. For the

sake of clarifying where I believe we now stand, I tried to combine the two cases

in the format of a rough draft of an Application in Exhibit B. Exhibit B contains extra information on Prior Art, new drawings, details of the preferred embodiments, examples, etc. It ends with the proposed definition of April 24, slightly modified to add some features that emerged as I tried to prepare the comprehensive write-up.

Please let me know how I can be of help in proceeding with this work, and thanks for the excellent start.

Best regards,

Dimitri Zafiroglu

EXHIBIT A

LIST OF PATENTS/APPLICATIONS FROM INTERNET SEARCH

1) WO 9919557 (Floorcovering with Woven Face) Interface, Inc. appears to be the basis for the commercial product "Solenium".

2) WO 5,965,232 (Decorative Composite Floor Coverings) E I. DuPont

3) WO 9941864 (Modular Flooring)

4. WO 0143925 (Modular Carpet Tile System)

5) WO 0153629 (Grouted Edge System)

6) WO 0111133 (Modular Edge Treatment)

7) WO 9955954 (Floor Covering With Integrated Tufted/Sewn Face)

8) WO 0006853 (Padded Flooring Panels)

9. WO 0056850 (Molded, Raised Panel Flooring)

COMMENTS ON TWO KEY REFERENCES VS. S-0001/S-0002

1. <u>EP 1023485/WO9919557 (TO INTERFACE INC.)</u>

- COMMERCIAL NAME :"SOLENIUM"
- FILED 1/13/98 (IN U.S. 10/13/97?)
- "FLOOR COVERING WITH WOVEN FACE"

  -WOVEN LAYER (FLAT)
  Optional pre-coat
  -"BACKING LAYER" UNDERNEATH
  Optional Reinforcement Layer
  -"BACKING FABRIC" BELOW BACKING LAYER

2. <u>USP 5,965,232 (TO DUPONT)</u>

- FILED 10/4/96
- "DECORATIVE COMPOSITE FLOOR COVERINGS"

  -DECORATIVE TOP LAYER WITH A PROTECTIVE POLYMER APPLIED AT LEAST ON TOP
  - "STABILIZING LAYER" UNDERNEATH
  -"CUSHIONING LAYER" UNDER "STABILIZING LAYER" AT LEAST 0.1 INCH THICK, DENSER THAN 3 LB/FT^3
  - COMPOSITE IS IMPERVIOUS TO LIQUIDS!

EXHIBIT B

S-0001/S-0002

TEXTURED LAMINATE SURFACE COVER

Field

This invention relates to an improved composite surface cover with a textured surface, intended for use in flooring, upholstery, wall coverings, automotive interior surfaces, and the like.

Related Art

Flooring products such as tufted, knit, knotted or woven carpets, and upholstery or interior wall coverings such as velours or velvets, provide abrasion and wear resistance, as well as cushion and a soft textile hand, by anchoring fibers onto a backing and holding them upright, either as standing loops or as standing "cut-pile" ends. Compared to "hard" surfaces such as wood, metal, marble or ceramic tile, these textile "pile" products are less durable, tend to collect dust and dirt, provide spaces that allow the growth of bacteria, and they are difficult to clean and sanitize.

"Solid" surface cover materials used in flooring or interior walls include "hard" surfaces such as wood or metal, and "resilient" surfaces such as vinyl or rubber. They do not have the dirt and bacteria problem of the textile products, but lack the softness and the textile quality of carpets and textiles. Hybrid structures, with partially fibrous and partially solid faces such as those described in Petry in USP 3,943,018, have also been developed. They reduce but do not eliminate the limitations of regular tufted, velours, or flocked textile surfaces.

Attempts have been made to provide flat or textured surfaces consisting of fibrous layers impregnated with a plastic matrix, exemplified by Goldstone USP 4,035,215 and USP 4,098,629, or Zafiroglu USP 6,063,473. The surfaces have a semi- fibrous feel. The spaces between the fibers may be sufficiently sealed to prevent bacterial penetration and dirt collection. They also provide somewhat higher abrasion resistance than regular pile structures. The aesthetics offered by these products, however, are those of a stiff leather rather than those of a textile, and the cost of preparing dimensionally-stable dense fibrous products, combined with the cost of impregnating and heat setting, result in very high overall costs.

Other attempts to resolve the problem have utilized flat or textured film-like skins placed on top of a pile-like surface, as described in Gregorian USP 3,860,469. These products combine the qualities of carpet with the solidity of vinyl or rubber, but lack the textile quality and aesthetics of carpets.

There have also been numerous attempts to combine a textile fabric placed over a

sublayer of adhesive, backed with various layers of sub-surface reinforcement, as exemplified by WO 9919557 (Interface/Solenium), which utilizes a woven face fabric backed by reinforcing layers. Another example is USP 5,965,232 (DuPont), wherein a decorative fabric is attached to dimensionally-stabilizing or cushioning layers, and it is further surface-stabilized. Other references (Exhibit A) also deal with fabric laminates and fabric laminate treatments. None provide the full range of soft textile hand, aesthetics and cushion of tufted, knit, woven or velour products although they may provide some barrier to dust and dirt. The difference in mechanical and thermal properties between the face layer and the sublayers also create thermal and dimensional stability problems. The "flat" orientation of the face fibers limit abrasion resistance. Furthermore the flat laminated surface layer tends to delaminate and "fray" at the edges because the yarn segments laying in the upper strata are not fully anchored to the backings.

Summary of the Invention

A fibrous surface layer, that may or may not be durable or abrasion resistant by itself, is pattern-embossed into an adhesive sublayer in a manner that causes the adhesive to surround and "anchor" essentially all of the fibers of the face layer within the recessed (pushed-in) areas. The elevated areas between the recessed areas retain at least some of their fibrous feel and hand. The surface fibers within the elevated areas are relatively free of adhesive and yet anchored into the structure within the adjacent recessed areas. The adhesive sublayer may be placed between the fibrous face layer and a third "backing layer" which provides dimensional stability and/or cushion. Alternately the adhesive layer may be eliminated by using a backing that has a "built-in" low-melting thermoplastic top layer, so that the fibers within the recessed areas are anchored directly into the backing itself. The backing may be solid, porous, or fibrous. The "adhesive layer" may be thermoplastic or thermoset, and may or may not block liquid penetration. A breathable liquid-blocking membrane may also be incorporated under the adhesive layer. The adhesive seals only the recessed/anchoring areas, leaving the elevated areas free to "breathe". In all cases the fibrous surface layer, either on its own or in combination with the adhesive sublayer, provides a dense barrier to dust and bacteria, and allows convenient sanitizing and cleaning.

The surface texture may consist of isolated discrete recessions or it may consist of an interconnected recessed network. The maximum span between recessed/anchored areas (the maximum length or width of the elevated areas) is kept small (0.5 to 4 mm, depending upon face layer characteristics) to preserve abrasion resistance. The depth of the recessions equals or exceeds the thickness of the surface layer at the elevated areas. (See Figure 1) With the depressions being, by the downward motion of the embossing tool the "legs" of surface fiber loops always stand at an angle larger than 45 degrees. (Fig 1)

Since the exposed active surface of the product is three-dimensionally contoured and anchored at small intervals, the dimensional stability of the product vs. changes in temperature or humidity is excellent, and only dependent upon the mechanical properties of the backing "Doming" due to expansion of the face layer and/or contraction of the backing, or "Curling" due to the contraction of the face and/or the expansion of the backing, are avoided.

This invention also involves a laminating process utilizing a deeply contoured heated embossing tool (press-plate, patterned calender roll, patterning belt) against the face layer. The temperature of the heated embossing tool is kept under the melting temperature of the surface layer fibers, but well above the thermoplastic melting or thermosetting temperature of the adhesive layer. The protrusions of the tool compress the face fibers to form the recessed areas and to melt (or activate) the adhesive layer within those areas, while the elevated areas remain relatively unpressed and free. Heat-conduction within the compacted areas of the face layer is much faster than conduction within the uncompacted areas. Temperature, exposure time, pressure, depth of protrusions/depressions, etc. can be adjusted to control the degree to which adhesive melts and penetrates between fibers. Tool protrusions can also be formed into sharper shapes that penetrate into the backing, and even through the backing (Figures 4A and 4B). A "soft" opposing tool may be used to facilitate penetration through the entire product.

Drawings

Figure 1A shows a typical cross-section of a product consisting of a face layer, an adhesive layer and a backing layer, wherein the face layer and adhesive layer have been embossed and anchored onto the top face of the backing. Figure 1B shows the same product with an additional breathable barrier layer.

Figure 2 shows a typical cross-section of a 2-layer product with a face layer thermally embossed into a lower-melting thermoplastic backing layer in a manner that melts the top part of the backing layer within the highly compressed, recessed areas to anchor the fibers of the face layer.

Figure 3 shows a 3-layer product with the "backing" layer consisting of a soft, compressible and cushioning upper portion, and a stiff, stable lower portion.

Figure 4A shows a three-layer product in which the embossing tool has relatively sharp tips that penetrate into the backing layer partially, exposing the color and texture of the backing layer within the perforated areas.

Figure 4B shows the perforations of the same type as Figure 4A progressing through the entire product thickness.

Figure 5 shows a process for producing a simple 3-layer product.

Preferred Embodiments

This invention provides for a three-dimensionally textured fibrous face layer anchored onto a backing by embossing into adhesive layer at small intervals. For three-dimensional texturing to occur in a manner that the depth of the depressed/anchored areas equals or exceeds the thickness of the face layer (See Figure 1), the fibrous face layer should be thermally deformable, so that it can conform to the embossing contour. Suitable face layers include nonwovens that are randomly-laid and mechanically or hydraulically entangled ("needle- punched" or "spunlaced"), or nonwovens that are

thermally bonded using a binder system that softens and yields at the temperature used to activate the adhesive layer. Spunbonded nonwovens such as Reemay® or Cerex®, or staple nonwovens containing low-melt thermoplastic binders, such as Cambrelle®, and the like are suitable. Most knit fabrics are eminently moldable and, therefore, suitable. Relatively heavy and loose wovens, that can shift and deform with localized pressure are also suitable. Particularly suitable are conformable stitch-bonded fabrics, such as those sold under the trade name of "Xymid" by Xymid, LLC. Fabrics woven, stitched or knit with elastic or shrinkable yarns are also suitable. Face layer weights range from 2 to 15 oz/sq. yd. Fiber deniers may range from microfibers (under 1 denier per filament) to 15-25 denier per filament. It is preferred that at least some of the surface fibers have a denier over 3, to provide abrasion resistance.

It was found to be particularly desirable to have free fiber ends or fiber loops underneath the surface layer, on the face adjacent to the adhesive layer, to improve anchoring, and to increase delamination resistance. Tight and highly-bonded face-layer fabrics, surface-bonded "spunbonded" filament-nonwovens, and tight filament wovens or knits may require sanding or brushing of their undersurface to raise ends or loops. Gathered fabrics with "loopy" surfaces are ideally suited and require no treatment, even if formed entirely with filament yarns. Tightly woven filament-based fabrics utilizing stiff yarns similar to those that are ideal for WO 9919557, are not suitable for this invention, unless sanded or brushed on the underside to raise fiber ends.

Ideally the face layer fibers utilize relatively high-melting fibers. Natural fibers such as cotton or wool, polyesters, polyamides, and high temperature fibers such as aramids are suitable. Lower-melting polyolefins are less preferred. Polyolefins would require thermoplastic adhesives melting at very low temperatures and would limit end-use-temperatures. Low-temperature thermoset adhesives could, however, eliminate this problem.

Suitable (and inexpensive) thermoplastic "adhesive" layers include simple polyethylene or polypropylene films, and most polyolefin-based nonwovens or fabrics. Any films or nonwovens can be utilized for this type of thermal patterned lamination. The higher melting fibrous face layer insulates the low-melting adhesive layer and prevents premature shrinkage with heat during the process. As the fibrous layer is compressed the projections of the embossing tool "fix" the thermoplastic adhesive sublayer in place before it starts to shrink. The process of this invention can use any low-melt films, including polypropylene, polyethylene, "Saran", etc., whether heat-set or dimensionally stabilized or not.

Thermoplastic adhesive materials that tend to be somewhat more crystalline and stiffer after use are preferred. Such adhesives can be based on polyesters or polyamides, modified to lower their melting points.

Such "adhesive" layers can consist of a film or of a layer of low melting polymer pulp or powder, or it can consist of an unbonded web of low-melting stiff fibers. Such adhesive layers would also have no "area shrinkage" problems.

Thermoset adhesive materials can consist of pastes or relatively viscous suspensions or solutions that can be applied to the face of the backing or to the underface of the face

layer, to be activated with heat during the embossing operation. As in the case of the thermoplastic adhesives, materials can be chosen to fully "set" (and envelop most fibers) at the depressed areas, whereas the elevated areas may be slightly, partially, or, if desired, fully penetrated by the adhesive, even when the adhesive reaches the surface fibers at the elevated areas it does so without the densification and tight bonding occurring in the compressed/recessed areas. (Even when the adhesive rises to the top surface of the face layer it does not fill all the spaces and does not anchor all fibers as in the recessed areas . The density of fiber/binder at the elevated areas is always much lower than that of the recessed/compressed areas.)

The backing layer can be soft or hard, solid or porous, fibrous or non-fibrous. It may be homogeneous, or it may consist of layers that have different levels of hardness, porosity or fibrous character. The backing ranges in weight between 4 and 80 oz/sq.yd, and in thickness between 2 and 20 mm, depending upon need. Preferred backings include those that have fibrous upper strata, which provide a better adhering and embossing surface. Particularly preferred are fibrous felted layers (needlepunched) with a large number of upstanding fibers or fiber loops present on their top surface. Elastic open foam layers, preferably backed with a relatively rigid sublayer, are also suitable.

The embossing patterns are designed to limit the distance between adjacent embossed points or lines to less than the thickness of the face layer in the elevated areas, and to less than 4 mm, preferably less than 3 mm. The height of the embossing protrusions is chosen so that the depth of the recessions exceeds the thickness of the face layer. Embossing patterns can be chosen to simulate the appearance of "loop-pile", with loop-like domes of fibrous skin supported by elastically-compressible fibrous or foamed backing segments under the face fabric. In this manner cushion is supplied by the backing material, and decoration, dust-blocking, abrasion resistance and textile feel by the fibrous face layer. As a result the face layer fiber weight is also minimized.

The color of the adhesive layer can be selected to cover and overcome the color(s) of the surface layer, so that when the adhesive layer flows between the fibers at the depressed areas it will color those areas, in contrast to the raised areas which retain their original color.

The embossing surface pattern may have projections of any pattern, uniform or variable, orderly or random, or specifically designed so that it would be outlined by color as well as by depth, by choosing the colors of the face layer, the adhesive layer and, in the case wherein the tool projections penetrate into the backing layer (Figure 4A), the color of the backing.

Numerous differential-depth colorations can be achieved by providing several layers of different colors within the backing that are penetrated and exposed by protrusions of different depths, to create complex/three dimensional color/texture designs. At the extreme the tool can be made to penetrate through the entire composite, as shown in Figure 4B.

A preferred process of this invention combines a fibrous surface layer with a melting point at least 30°C above the melting point of a thermoplastic adhesive layer. The thermoplastic adhesive layer may be in the form of a film of a nonwoven web or on a

fabric, on in the form of a layer of powder or pulp. Preferably the surface layer has a "rough" under-surface, with loops or ends of fibers emanating from its undersurface. The thermoplastic adhesive layer may also consist of the upper stratum of the backing itself. The embossing tool is heated to a temperature 10-40 degrees C above the melting point of the adhesive layer, but 10-20°C under the melting point of the fibrous layer. Pressure and heat are applied for a short time that can range from a small fraction of a second to several seconds. The projections on the tool transfer heat to the recessed areas of the composite vary rapidly, while the areas between the projections rise to a lower temperature because of the lower heat-transfer-coefficient of a fibrous layer that is less-compressed. Pressure, time, and depth of projections can be adjusted so that, as needed, the binder melts not only at the recessed areas to envelop the fibers of the face layer, but also under the elevated areas, to envelop some of the fibers adjacent to the thermoplastic adhesive layer. The binder can also be caused to penetrate partially or totally into the face layer within the raised areas.

The process may also involve the simultaneous surface bonding of the upper strata of the face layer while the tool protrusions fully-melt the binder at the depressed areas. One example is to use a web, nonwoven or woven/knit fabric that contains a small percentage of thermoplastic binder (in the form of fibers, or in the form of powder or as low-melt/high melt bicomponent fibers) melting at approximately the same temperature as the binder layer. Because of the differential pressure and the different rates of heat transfer the upper surface of the face layer is bonded and stabilized while the lower layers remain relatively bulky and soft.

The process can also be adjusted to provide a vapor-permeable (or totally impermeable) liquid barrier, either by using a thermoplastic layer in the form of a film or membrane that may be melted but not penetrated at the depressions, or by adjusting heat/pressure cycles to create a solid barrier, by causing the melted thermoplastic adhesive to fill the interstices between the fibers sufficiently to block liquid flow (or to prevent liquid flow through, until high hydrostatic pressure is applied, resulting in "high-hydro-head" resistance), but to leave a sufficient amount of small breathing passages to allow moisture-vapor to escape from the underfloor.

The process can also involve the simultaneous solidification and stabilization of the underside of the backing, or the simultaneous lamination of a stabilizing sheet onto the backside of the backing. Melting and/or adhesive activation temperatures on the opposite side of the face-embossing roll or platen can be raised to perform the lamination on the back side without affecting the front face and without melting or crushing the entire backing. Heat transfer within short pressing cycles will limit the depth of melting to the lower strata of the backing layer.

EXAMPLE #1

- **Face Layer**
  5.5 oz Felt, 15 DPF/1.5" PET Staple
  Card/Lap, 300 + 300 Pen/Sq. In.

- **Adhesive Layer**
  2 Layers Black P.P. Film, Total 4.4 oz/sq. yd.

- **Backing**
  26 oz/sq. yd. Nylon/PP Waste Felt, ½" thick

- **Plate** (Front Only)
  Staggered 9 x 9/inch round projections, 0.060 inch diameter,
  0.060 inch Deep, 81/sq. inch, 8" x 11"

#	Plate Temp	Back Temp Flat	Press, PSI	Time Sec	Final Thickness In	Depth Recesses In	Comment
1A	220°C	25°C	3000	0.5	0.40	0.050	Soft Cushiony Gray Recesses
1B	220°C	25°C	3000	1.0	0.25	0.055	Stiffer Dark Gray Recesses
1C	220°C	25°C	3000	2.0	0.10	.060	Stiff Perforated
1D	220°C	220°C	3000	0.5	0.25	.050	Soft Face Stiff Back
1E(X)	220°C	220°C	3000	1.0	0.25	.050	Resilient Face Stiff Back
1F(X)	220°C	220°C (P)	3000	1.0	0.30	.050	Resilient Face Stiff Back

(x)=Added "Face-Felt" on Backside

(p)=Pattern Plate also on Back

EXAMPLE #2

- **Face Layer**

  Xymid® Style 1817, (Reemay® 2024, 2.1 oz/sq. yd.) stitched with Textured Nylon 14 Gauge, 12 CPI, 34% overfeed chain 10-10, shrunk & heat-set during dyeing process by ~30% MD.

- **Adhesive Layer**

  Sprinkled low-temperature polyamide powder. Melting pt. 105°C, total weight 1.5 oz/sq. yd, over 3 oz/sq. yd melt-blown polypropylene.

- **Barrier Layer**

  Melt-blown polypropylene, 3 oz/sq.yd.

- **Backing Layer**

  26 oz/sq. yd nylon/PP waste felt, ½" thick, with 1 oz/sq. yd adhesive powder sprinkled on top.

- **Plate**

  Staggered 9x9/inch round, 0.060 inch diameter, 0.060 inch deep, 81/sq. inch, 8" x 11".

#	Face Temp	Back Temp	Press	Time	Final Thickness	Depth Recesses	Comment
2A	170°C	25	2000	0.5	0.45	0.050	Full Bonds at Recesses Partial Bonds at raised Areas.
2B(NP)	220°C	25	2000	0.5	0.45	0.050	Full Bonds at recesses No Bonds at Recessed Areas
2C(UN)/NP	220°C	220oC	2000	0.5	0.50	0.050	Same as 2B but Stiffer Back

(NP) Removed powder layers
Doubled melt-blown layer

(UN) Same as 2B but added 1" staple fiberglass web, 3 oz/sq. yd underneath

EXAMPLE #3

- **Face Layer**

  Reemay® 4 oz/sq. yd Style 2040

- **Adhesive**

  Black Polypropylene, 2 layers 4.4 oz/sq. yd. total

- **Backing**

  20 oz/sq. yd felt carded, cross lapped, needled with 150 insertions per sq. in. top 1/3 stained yellow, ~3/8" thick, 15 DPF/3" polyester

- **Plate X** (220°C)

  0.040 deep, (196 indentations/sq. in.) Round staggered pattern

- **Plate Y** (220°C)

  0.060 deep x 0.060 Diameter (81 indentations/sq. in.) Round staggered

- **Plate Z** (220°C)

  8 mesh screen, 3/16 inch thick (16 indentations/sq. in.). Elongated, cross-laid.

#	First Plate	Second Plate	Third Plate	Press PSI	Time Sec	Thickn. Mils	Recess Mils	Notes
3A	X	Y	-	7000 (All Plates)	1.5/1.5	.35	.035(X) ,034(Y)	Raised areas white Indent X Gray Indent Y Dark Red
3B	X	Y	Z	7000 (All Plates)	3.5	.30	.03 (X) .04 (Y) .15 (Z)	Raised White MD X Gray IND Y Red/Purple IND Z Dark Brown

EXAMPLE #4

- **Face Layer**

  Woven Staple Cotton/Nylon Upholstery Fabric, Approx. 25/25 per inch, total 12 oz/sq. yd.

- **Adhesive**

  Black Polyethylene Film 3.2 oz/sq. yd

- **Backing**

  Commercial 26 oz/sq. yd. Nylon/PP Waste Felt, ½" thick

- **Plate X**

  0.040 Deep, (196 indentations/sq. inch). Round Staggered Pattern

- **Plate Y**

  0.060 Deep, (81 indentations/sq. inch). Round Staggered Pattern

#	Plate/ Temp	Press	Time	Thick	Recesses	Comment
4A	X/200	7000	0.5	.40	.030	Can be delaminated
4B(SA)	X/200	7000	0.5	.40	.030	Does not delaminate
4C	Y/200	7000	0.5	.40	.051	Does not delaminate
4D	X/200	20,000	0.5	.30	.035	Does not delaminate
4E	X/200	3000	1.5	.40	.020	Does not delaminate
4F(NA)	Y/200	20,000	1.5	.20	.055	Does not delaminate

(SA) Underside Sanded with 60-gram Sandpaper

(NA) No Adhesive Layer

EXAMPLES

EXAMPLE GROUP #1

This group demonstrates a basic three-layer product, and the capability of the process of this invention to adjust thickness, stiffness, surface texture, and back texture, by manipulating embossing pressure, temperature and time.

The "face-layer" consisted of a lightly needlepunched "felt", prepared by carding and cross-lapping Type 510, 1.5 denier, 1.5 inch polyester fibers from "Wellman". The needling density was 300 penetrations per square inch through top and the bottom. The needled feet had an uncompressed thickness of 2.2 mm and weighed 5.5 oz/sq. yd.

The "adhesive layer" consisted of two layers of black polyethylene utility-film, totaling 4.4 oz/sq. yd.

The "backing layer" consisted of a commercial carpet underpad, weighing 26 oz/sq.yd and containing approximately 50% Nylon and 50% polypropylene post-consumer carpet waste. The reclaimed fibers were garnetted, cross-lapped and mechanically needled to a thickness of approximately 0.5 inch. (12.3mm).

The patterning/embossing tool(s) consisted of electrolytically-formed nickel plates, with projections roughly 0.080 inches in diameter at their apex and 0.060 inches deep, arranged in a staggered manner, 9/inch in each direction, approximately 81 per square inch. The largest gap between two alternate rows, constituting the largest distance between non-bonded areas, was approximately 0.142 inches (or 3.5 mm).

The samples were formed using a platen press applying approximately 3000 psi. The top plate (adjacent to the face layer) was heated to 220°C. The bottom plate was kept at room temperature, except for Examples 1D, 1E & 1F, in which the bottom plate was also heated to 220°C. The samples were laminated by raising the bottom plate, followed by quick release to allow cooling.

Item #1A was prepared using a pressing time of ½ second, and quickly releasing the pressure to part the platen. The composite was tightly bonded, with the recessed areas approximately 0.050 inches deep. The recessed areas changed to a light gray color because of the flow of the black polyethylene into the interstices between the white face fibers. The composite was approximately 0.40 inches thick, with the bottom flat and relatively soft, and a compressive cushion feel similar to a dense tufted carpet.

Item #1B was prepared in an identical manner to Item #1A except that heat and pressure were applied for a longer time (1 second). The backing layer was further compacted. Product thickness decreased to 0.25 inches. The recessed areas were further inbedded in black polyethylene and appeared darker. The product was stiffer and firmer as compared to Item #1A.

Item #1C was compressed for an even longer period (2 seconds). It collapsed into a quite solid and stiff configuration. The recessed areas were mostly perforated through. It recovered to a thickness of 0.10 inches and had the feel of a dense vinyl tile with the

elevated areas having a fibrous but semi-plastic feel, with a light gray color because of the preparation of the molten polyethylene into the face layer.

Item #1D was prepared identically to Item #1C, but with both top and bottom plates heated to 220°C and with pressure applied for only ½ second. Heat propagated from above and below to achieve lamination on the top and solidification of the flat backside as the polypropylene fibers within the backing melted to a limited depth (approximately 0.050 inches).

Item #1E was prepared in an identical manner to Item #1D, but with an additional layer of a felt, identical to the face layer, placed against the bottom, with top and bottom plates heated to 220°C. Pressure was applied for 1 second. A stiffer, more resilient and more stable product was obtained as compared to Item #1D.

Item #1F repeated the process of Item #1E, except that two pattern-plates were used on both the front and back. The two patterns did not run into each other. The backside of the laminate was textured (and less slippery), and remarkably well anchored in the Nylon/polypropylene bedding without the need of an added polypropylene film.

EXAMPLE GROUP #2

This group demonstrates the use of a "breathable barrier" layer, and the capability of the process to "surface-stabilize" the "face layer" during the laminating step.

The "face layer" consisted of Xymid® Style 1817, which is a stitchbonded post-shrunk product obtained from Xymid, LLC of Petersburg/Virginia. The fabric utilized unbonded Reemay® Style 2024 2.1 oz./sq. yd, stitched with chain stitches of partially-oriented polyester yarn (14 gauge, 9 CPI) and gathered in the machine direction by a ration of 1.3/1 as it was dyed to a light blue color. The result was a highly-conformable, 3-dimensional textured fabric weighing 4.2 oz/sq. yd. The binder system in the Reemay® (the low melting copolymer within the Reemay®) was not activated during the dyeing operation.

The adhesive layer consisted of a spread layer of low-melt polyamide powder obtained from the EMS Company, CMS, Switzerland. It had a melting point of 105°C. Approximately 1.5 oz/sq. yd. of this powder was spread over a layer of meltblown microfiber polypropylene weighing 3 oz/sq. yd., which acted as the "breathable liquid barrier".

The "backing layer" was the same 26 oz/sq. yd. carpet waste sheet of Example 1. To help adhesion a thin layer of the EMS adhesive powder was also applied to the top face of this backing.

The patterning plate was the same 81/sq. inch plate used in Example Group 1.

Item #2A was laminated with the patterning plate at 170°C (and the flat back-plate at room temperature) by pressing for 0.5 seconds. The laminate thickness was approximately 0.45 inches, with the recessed areas well-formed and 0.050 inches deep, and with clear bonds visible within the recesses. The product had excellent resistance to delamination, with the bonds at the recessed areas being very strong. Within the raised areas there was also extensive interface bonding (of the face fabric to the barrier and the barrier layer to the

backing. The product was resistant to liquid penetration (resisting water flow from a column of water at least 10 inches high) and quite breathable (allowed fine smoke to be blown through).

Item #2B was prepared in an identical manner to Item #2A except that no powder layers were used, while the meltblown layer was doubled to 6.0 oz/sq. yd., and the face plate temperature was raised to 220°C. Successful bonding/lamination with simultaneous stabilization of the face layer (by activating the Reemay® copolymer) was achieved. The meltblown layers were fully molten and sealed at the recessed areas but almost intact at the raised areas. Liquid penetration resistance and breathability were equivalent to Item #2B.

Item #2C was identical to Item #2B except that a web of 1 inch long glass staple (Type K) was added on the bottom, and the bottom plate was also heated to 220°C. The product was very similar to Item #2B except that it was much stiffer and more dimensionally stable.

EXAMPLE GROUP #3

This group demonstrates that multiple designs with different depths and different pattern scales, can be embossed into a product to reveal the colors of the adhesive or the color of the backing at the level to which the embossing tool penetrates. It also demonstrates that a moldable spunbonded product that contains binder melting below the embossing tool temperature can be used to simultaneously stabilize the face-layer. Furthermore it shows that a felt structure that does not contain low-melting fibers can be used to achieve thicker and more cushioning structures.

The "face-layer" consisted of commercial Reemay Polyester Type 2040, 4.0 oz/sq. yd. This product is moldable at temperatures over 150°C. The adhesive layer was identical to that used in Example 1.

The backing was prepared using 15 denier-per-filament, 3" long Polyester Staple sold by "DAK Americas", carded, cross-lapped and needlepunched into a resilient 20 oz./sq. yd. felt, using 150 penetrations per square inch per side. The resulting felt was approximately 3/8 thick. The product was stained red on the top using concentrated commercial red dye dissolved in water, and "set" by drying in an oven at 130°C. The color penetrated through approximately 1/3 of the thickness. The process was then repeated with dark green dye on the back, with equivalent results.

Three different patterning plates were used to emboss the product. Plate X had 196 staggered protrusions per sq. inch, 40 mils deep. The projections had a diameter of approximately 40 mils at their tops.

Plate Y was the same coarser and deeper plate used in Examples 1 and 2.

Plate Z was a woven metal screen 8-gauge, which had elongated projections alternating at 0 and 90 degrees, spaced at a distance of 4/inch in a staggered pattern (16 per sq. inch), the patterning tools (plates, screen) were heated to 220°C. The backside of the product was pressed against a flat metal press plate held at room temperature.

In Example 3A the product was first processed with Plate X, as shown in Table III, resulting

in 0.035 inch deep recessions, with the recessed areas assuming a gray color and the raised areas remaining white. When Plate Y was subsequently applied it penetrated sufficiently into the backing to produce indentations 0.045 inches deep superposed onto the original pattern with a dark red color. The original recessions produced by Plate X remained unchanged.

In Example #3B the process was repeated and then continued by applying Plate Z, which penetrated further and picked up a dark brown color at the recessions made by Plate Z. The original colors at the raised areas and at the original recessions produced by Plates X and Y did not change. Remarkable in both cases of #3A and #3B the thickness of the laminate stayed above 0.3 inches.

EXAMPLE GROUP #4

This group utilized a generally non-moldable woven fabric product as the face layer, with sufficient space between the woven yarns, and sufficient yarn bulk, to achieve the general effect of this invention. The series illustrates the capability of the process of this invention to control layer adhesion, overall thickness, density, and surface texture by applying different levels of pressure, for different periods of time, and also by creating free fiber ends by sanding the backside of the face layer fabric.

The "face layer' was a commercial Cotton/Nylon woven upholstery fabric made of spun yarns with a 20 x 20 weave, weighing 12 oz./sq. yd. The thickness of the fabric was approximately 1 mm.

The "adhesive layer" was black polyethylene film, 3.2 oz/sq. yd.

The backing was identical to the backing used in Examples 1 and 2. The patterning plates X and Y were those used in Example 3.

In Example 4A relatively low pressure (3000 psi) and a short pressing cycle (0.5 sec) were used to emboss and laminate using the finer Plate X. The product retained in bulk and developed a clear embossed surface pattern with 0.030 inch deep recessed areas, but it was delaminatable without excessively tearing-up the surface layer or the backing.

Hand-sanding the backside of the face fabric with 60-grit sandpaper (Example 4B) improved delamination resistance so that the product could not be delaminated without seriously damaging the face layer or the upper surface of the backing. The product retained high bulk, equaling the bulk of Example #4A.

Using a coarser and deeper patterning plate (Type Y) in Example 4C, without pre-sanding, also achieved high bulk/cushion with very high delamination resistance.

Equally high delamination resistance without pre-sanding, was also achieved in Example #4D using the finer patterning Plate X and increasing pressure to 20,000 psi.

The same result with higher bulk was achieved in Example 4E at only 3000 psi by extending exposure time to 1.5 seconds. Finally it was demonstrated in Example 4F that high delamination resistance can also be achieved by increasing both pressure and temperature

and using the coarser-Plate "Y", without sanding the face layer, and without using a separate adhesive layer, simply by melting the polypropylene fibers within the backing.

Throughout Examples 1 to 4 the distance between recessed areas remained under 4mm, the depth of the recessions exceeded the thickness of the face layer, as shown in Figure 1 ($Dn \geq Tf$). It was also observed that the shape of the raised sections mostly resembled that of loop-pile structures with the angle of the face fabric rising from the recesses being quite steep.

Stiffer or more elastic adhesive/binder materials than those described in Examples 1-4 above can also be used to form textures less likely to "creep" under pressure. They include elastic thermoplastics such as polyurethanes, thermosets applied as a relatively viscous pastes.

PROPOSED CLAIMS/DEFINITION (S-0001/S-0002)

A. **PRODUCT** (Fig 1)

(1) A composite floor, wall or seat surface covering, consisting of

- A fibrous "face" layer (a fabric or web containing staple or filament fibers), having a thickness Tf and a basis weight Wf in the range of 2-15 oz/sq.yd.
- An "adhesive" layer with a weight of $W_A \leq ¼ W_F$
- A "base" layer with a thickness $T_B \leq 1$ mm and a weight $W_B \leq 2$ Wf,

wherein

- The face layer is indented (embossed) into the adhesive and base layers over 5-85% of its surface area, with an average depth $D \leq Tf$.
- Essentially all fibers of the face layer within the indented and recessed areas are contacted by adhesive.

(2) Product of (1) wherein the base layer is porous

(3) Product of (2) wherein the base layer is fibrous

(4) Product of (1) wherein the base layer and adhesive layers consist of a single thermoplastic layer.

(5) Product of (1) wherein D is 1-10 mm

(6) Product of (1) wherein the non-indented areas of the face layer are substantially free of adhesive on their exposed surface.

(7) Product of (1) wherein the non-indented areas of the face layer have at

east one dimension smaller than ¼ inch (6 mm).

(8) Product of (1) wherein the adhesive is water-repellent.

(9) Product of (1) wherein the water penetration resistance of the product is at least 10 cm of "hydrostatic head", and the air vapor permeability is above 150 mg/sq.m./24 hr.

(10) Product of (1) wherein the entire face layer is impregnated with a thermoplastic polymer.

(11) Product of (1) wherein the composite is water-impermeable.

(11a) Product of (1) wherein the indentations go through the entire product.

(12) Product of (1) or (4) wherein the base layer further contains a stabilizing/cushioning sublayer on its bottom surface opposite to the face layer.

(13) Product of (1) wherein the indented/recessed areas assume some of the color of the adhesive by being largely imbedded in the adhesive, whereas the non-indented/elevated areas retain their original color.

(14) Product of (13) wherein the adhesive layer has a color pattern that is visible through the compacted/indented/recessed areas.

(15) Product of (12) wherein the base layer is softer and more compressible near the top adjacent to the face layer to provide a cushioning effect, and dense and stable in the lower strata to provide dimensional stability.

(16) Product of (1) wherein the fibrous face layer exhibits free fiber ends or loops imbedded in the adhesive layer or backing.

(17) Product of (1), wherein at least some of the indentations create perforations through the binder layer exposing the color(s) of the base layer.

B. **PROCESS**

(18) A process of forming a layered composite wall/floor/seat covering fabric by combining

- a fibrous face layer weighing 2-15 oz/sq.yd
- an adhesive layer weighing 0.5-15 oz/sq.yd
- a base layer weighing 4-80 oz/sq.yd,

characterized by

- using a three-dimensionally patterned heated forming tool that forms indentations that, on the average, are at least as deep as the thickness of the fibrous face layer within the noncompressed areas, and cover 5-85% of the entire surface area

- causing the adhesive to flow into the face layer and to contact most of the fibers of the face layer located within the indented/depressed areas

- curing the adhesive to form a surface-textured three-dimensional face-textured composite

(19) Process of (17) wherein the adhesive layer is thermoplastic and the forming tool is heated above the meeting point of the thermoplastic adhesive layer, but below the melting point of the fibers of the surface layer

(20) Process of (17) wherein the forming system is a platen-press.

(21) Process of (17) wherein the forming system is a heated calender with the roll contacting the face layer being a heated patterned roll.

(22) Process of (17) wherein the composite is "heat-set" by heating to at least 120°C and cooling while the product is held in a flat/planar configuration.

(23) Process of (17) wherein the face layer is a
- nonwoven
- moldable woven
- knit
- card web
- airlaid web
- spunlaid web
- knit with exposed loops
- woven of staple based spun yarns
- stitchbonded composite
- creped fabric

(24) Process of (17) wherein the adhesive layer is
- a thermoplastic web or fabric
- a thermoplastic film
- a thermoset coating
- a layer of low melt pulp
- a layer of low-melt polymeric powder

(25) Process of (17) wherein the base layer is
- a thermoplastic sheet
- a needlepunched nonwoven
- a woven

(26) Process of (17) wherein the face layer or base layer are sanded or

brushed to raise free ends or loops at their surfaces adjacent to the adhesive layer.